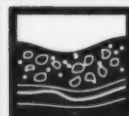


FACTSHEET



AGRICULTURAL
ENGINEERING



SOILS

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Ministry of Agriculture,
Food and Rural Affairs

Nutrient Management Act 2002

CONSTRUCTING A PERMANENT SOLID NUTRIENT STORAGE FACILITY

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The following document provides recommendations to address the construction of solid nutrient storage facilities as required by the Nutrient Management Act, 2002 (NMA) and the associated Regulation [O. Reg. 267/03, as amended to O. Reg. 511/05]. *Figure 1* shows a covered, solid manure storage structure.



Figure 1. A covered, solid manure storage reduces or eliminates runoff.

SCOPE

This Factsheet applies to permanent solid manure storages constructed using concrete, wood or equivalent material having 14 or more days of storage capacity.

Note: The NMA Regulation provides detailed requirements for larger solid manure storage structures. For smaller solid manure structures, the Regulation only applies to siting and runoff management criteria if the structure meets the following three conditions:

- a volume less than 600 m³;
- a surface area less than 600 m² and
- a wall height of 1 m or less.

KEY POINTS

- All storage facilities must have proper runoff management.
- Proper setbacks from sensitive features such as wells, surface water and conflicting uses must be met.
- Any perforated tile drain close to the storage must be removed unless it is required for a foundation drain.
- A professional engineer or geo-scientist may need to be engaged to determine that proper soil conditions exist if the storage has an earthen floor. This requirement depends on size of storage and number of livestock units on the farming operation.
- A building permit is normally required for structures with a floor area larger than 10 m².
- An engineered structure is normally required where the floor area is larger than 600 m² or if the retaining wall height is greater than 1 m. For more information, contact your municipal building official.

SIZING

For a regulated farm, the storage must contain 240 days of manure and bedding production¹ from the attached livestock facilities, with the following exceptions:

- If the farmer sends some of the manure to a broker and the aggregate storage capacity of the broker and the farmer is 240 days. For example, a broiler chicken

¹ The manure and bedding production must be based on numbers shown in Table 3.1 of the Nutrient Management Protocol. MSTOR, a computer program developed by OMAFRA, will include these data and can be used to complete the calculations.

operation has an agreement with a broker who can provide 60 days of storage. The manure storage at the broiler chicken operation would only have to be designed for 180 days.

- If the period of use of the barn is less than 240 days. For example, a beef feeder operation houses the animals for 180 days from November 1 until they go to pasture on May 1. The manure storage would only have to be designed for 180 days.
- If the farmer's nutrient management plan permits lesser periods of storage, (e.g. a NMP demonstrates that manure can be applied at a frequency that is less than 240 days); or
- If the farmer's nutrient management strategy permits lesser periods of storage via the use of transfers out of the farm unit (e.g. a dairy farm transfers its manure off-site every 3 months to another farm unit). The manure storage at the dairy farm would only have to be designed for 3 months.

SITING

All of the following criteria must be met:

- **Well setback** – the NMA Regulation requires that any new or expanding storage be at least:
 - 15 m from a drilled well that has a depth of at least 15 m and a watertight casing that extends to a depth of at least 6 m below ground level;
 - 100 m from a municipal well and
 - 30 m from any other well.
- **Flow path requirement** – the NMA Regulation specifies that a farm, constructing or expanding a nutrient storage must have at least a 50 m separation to surface water or tile inlet or have a flow path that is at least 50 m (165 ft) long. The flow path is the distance over ground any liquids would have to flow from the storage before entering surface water or a tile inlet. *Figure 2* shows that this flow path does not necessarily follow a straight line.
- **1 in 100 Flood Line** – The NMA Regulation requires the storage to be constructed outside of any one in 100 year flood line that has been established by a municipality or Conservation Authority unless a permit for the storage is issued under section 28 of the Conservation Authorities Act. Flood lines have not been determined for all susceptible areas.

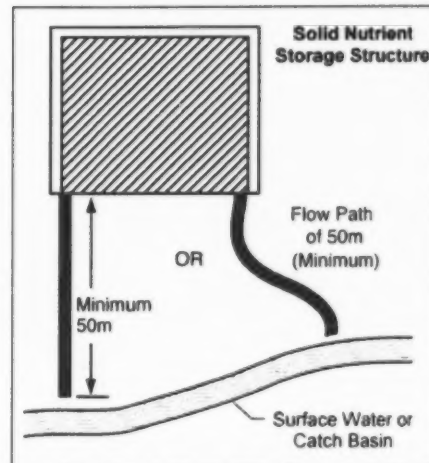


FIGURE 2. A flow path does not always follow a straight line. This required flow path is used to provide opportunities for flow control in the event of a spill.

- **Field tile drains** – All perforated drains within 15 m (50 ft.) must be located, intercepted and removed. Any flow from a field drainage system or piped municipal drain must be redirected away from the storage.
- **Structural tile drains** – the following two options can be used to manage water from a perforated foundation drain within 15 m of a manure storage facility:
 - Any perimeter drain for the storage must run through an observation and shutoff station prior to entering another drainage system or surface water. *Figure 3* shows a typical observation and shutoff station used to provide access to the tile drain. This special catch basin has two purposes:
 1. It allows observation of leakage from the storage to the foundation drains.
 2. It is used to shut off the flow and allow steps to be taken to identify and deal with the leakage.
 - Collect the foundation drain water and discharge it to a treatment system.

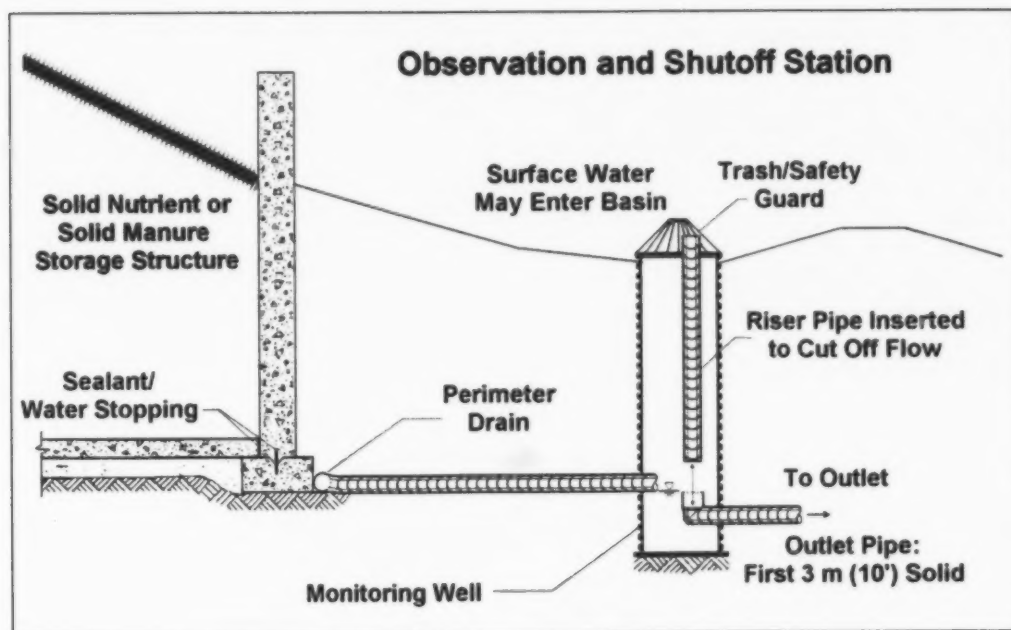


FIGURE 3. An observation and shutoff station is used to provide access to a perimeter drain if required. Possible contaminated flow can be observed and blocked. Steps can then be taken to address the situation.

SETBACKS THAT ARE NOT SPECIFIED IN THE NMA REGULATION

Minimum Distance Separation (MDS II) formula

- MDS II determines minimum separation distances between proposed new, enlarged or remodeled livestock facilities and/or permanent manure storages and other existing or approved development (e.g. neighbouring houses, areas zoned residential, lot lines, road allowance, etc.)
- MDS II is triggered when a building permit is required. In addition, Best Management Practices recommend that the MDS II formula be followed in all cases and this is referenced in the Provincial Policy Statement, 2005, policy number 1.1.4.1 (c):
 - 'New land uses, including the creation of lots, and new or expanding livestock facilities shall comply with the minimum distance separation formulae'
- The term livestock facility is defined in the new MDS-2005 as
 - 'Permanent structures with livestock-occupied portions, intended for the keeping or housing of livestock, including feedlots, and containing one or more barns or structures, Includes manure storages, whether associated with a livestock facility or not'

- For more information, contact an OMAFRA Nutrient Management Consultant or local OMAFRA engineer.

Other Municipal setbacks

- Contact your municipality for more information on other required setbacks.

RUNOFF MANAGEMENT

All solid manure storages must have provisions for managing runoff from the facility. Options are as follows:

- **Roofing** – if upslope water has been diverted away from the facility, a roof may be used to prevent entry of precipitation and thus avoid runoff. For this option, it is recommended that the manure be quite dry (>30% dry matter content to avoid runoff from the manure itself).
- **Vegetated Filter Strip (or equivalent system)** – a vegetated filter strip system, designed by a qualified professional may be used to manage runoff. A Certificate of Approval from the Ministry of Environment is required for this system. A Memorandum of Understanding between the OMAFRA and the Ontario Ministry of the Environment (MOE) to streamline this process has been implemented. For more information, contact an

OMAFRA Nutrient Management Specialist or Engineer.

- **Runoff Collection and Storage System** – this system must be designed and installed meeting all the criteria for a liquid nutrient storage system. For additional details, please refer to OMAFRA Factsheets Order No. 06-001, *Constructing a Concrete or Steel Liquid Nutrient or Runoff Collection Storage Facility* and Order No. 06-005, *Constructing an Earthen Liquid Nutrient or Runoff Collection Storage Facility*. This runoff storage system must have the capacity to hold at least 1.53 L of effluent per day per square metre of unroofed surface area of the solid storage plus any liquid portion of the manure.

- For example, a farmer has an unroofed solid manure storage facility, holding very dry manure, which has a dimension of 30 m x 20 m. He wants to build a runoff storage capable of holding 240 days of runoff. The runoff storage is required to hold a volume of $(1.53 \times 30 \times 20 \times 240) = \text{approx. } 220,000 \text{ L or } 220 \text{ m}^3$.

In addition, the capacity of the runoff storage must be calculated considering direct precipitation and freeboard. OMAFRA has a software package called NMAN to assist with this calculation or the necessary tables are contained in the Nutrient Management Protocol, August 12, 2005.

- **Permanently Vegetated Flow Path Option** – this option can be considered if the solid manure storage:
 - holds manure with a dry matter level of 30% or greater
 - has a surface area less than 300 m² and
 - has upslope water diverted.

The distance from the storage to surface water or any tile drainage inlet must be at least:

- 150 m long if the stored manure has a dry matter content of less than 50% or
- 50 m long if the stored manure has a dry matter content equal to or greater than 50%.

This permanently vegetated flow path must be located on a minimum of 0.5 m of soil, and not be located within:

- 3 m of a field tile drain
- 100 m of a municipal well
- 15 m of drilled well that has a depth of at least 15 m and a watertight casing that extends to a depth of at least 6 m below ground level
- 30 m of any other well.

PROFESSIONAL INVOLVEMENT

For the construction or expansion of most (see section entitled, "Scope" for storage structures that may be excluded from this part of the regulation) permanent solid nutrient storage structures O. Reg. 267/03 [as amended by O. Reg. 511/05] requires that professionals complete the following:

- **Design** – a professional engineer must design the construction or expansion, including any monitoring system
- **Site Investigation** – a professional engineer or a professional geoscientist must carry out a site characterization assessment if:
 - the farm unit generates greater than or equal to 300 Nutrient Units; and
 - if an earthen floor option is chosen

This site investigation must establish that there is 0.9 m of soil with a clay content of 15% or 0.5 m of hydraulically secure soil between the bottom of the proposed facility and the uppermost identified bedrock or aquifer.

ADDITIONAL PROFESSIONAL REQUIREMENTS

- There may be other municipal or provincial requirements including:
 - For a permanent solid nutrient storage structure (greater than 600 m² or with a wall height greater than 1 m) the building permit process requires that an engineer provide a design for the structure, meeting the requirements of the Ontario Building Code and the National Farm Building Code for Canada.

SPECIFIC CRITERIA REQUIRED BY THE NMA REGULATION FOR MOST SOLID NUTRIENT STORAGE

(see section "Scope" for storage structures that may be excluded from this part of the Regulation)

- **General design** – the facility, including any associated plumbing systems must be "designed to minimize leakage, minimize corrosion and to be structurally safe and sound." [O.Reg. 267/03, as amended, s. 71(1)(b)]
- **Floors** – a floor for a permanent, solid nutrient storage facility must be constructed using:
 - a concrete floor or equivalent floor that a professional engineer determines will provide equivalent protection to a concrete floor
 - a floor made of earth, consisting of 0.5 m of hydraulically secure soil or

- a floor made of earth, consisting of 0.5 m of C or D type soil as defined by the drainage guide where the farm unit is not sufficient to generate 300 or more nutrient units. [O.Reg. 267/03, as amended, s. 80]
- **Concrete floors** – if a concrete floor is used as part of a permanent solid manure storage facility, it must be a minimum of 125 mm thick unless a professional engineer specifies otherwise. [O.Reg. 267/03, as amended: section 72(2)]
- **Type of concrete** – if used, concrete must be strong and durable enough to resist the environmental conditions and must protect the reinforcing steel (if used) from potentially corrosive environments. [O.Reg. 267/03, as amended, s. 72(1)]

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APPENDIX A: SITE CHARACTERIZATION/INVESTIGATION CRITERIA SPECIFIED IN THE REGULATION

Site characterization is a process followed for all new, permanent liquid manure storage structures to determine how much protection is provided by the natural environment on the proposed building site. A basic site characterization evaluation considers the soil type and water table location, etc. In cases where the natural site does not provide sufficient protection, it may be necessary to use a synthetic liner, a geo-synthetic liner or an engineered soil (usually clay) liner to enhance the protection for surface and/or ground water.

You must hire a professional engineer or professional geoscientist to make the site assessment. OMAFRA can provide a partial listing of engineering and geotechnical companies familiar with agricultural projects. These individuals will take soil samples and investigate the location of permanent and naturally or artificially occurring water tables. These tests can be carried out by boring machine or backhoe/excavator. The machine must be capable of boring or excavating to a minimum depth of 1.5 m below the lowest excavation for the structure. If an earthen floor is desired, the depth of investigation must be 2.5 m below the lowest excavation for the structure. One borehole or excavation is required per 1,000 m² of ground floor area for the facility being constructed. The engineer or geoscientist may require more samples to be taken, due to site conditions.

The soil samples must be evaluated by a geotechnical laboratory to determine their physical properties. The geotechnical evaluation will determine if the soil provides a level of protection equivalent to OMAFRA's guidelines. These guidelines are listed below:

The saturated hydraulic conductivity of the soil is a measure of how rapidly water (and nutrients) can move through the soil. For protection of the environment, slower is better. Hydraulically secure soil has a maximum saturated hydraulic conductivity of 1×10^{-8} m/sec. An indication of the saturated hydraulic conductivity of the soil can be obtained by several means:

- by following a standard in-situ or laboratory testing procedure according to American Society of Testing and Materials (ASTM) or Canadian Standards Association (CSA) standards; or
- by evaluating soil particle size and Atterberg test data. The following are the recommended ranges that will provide the required level of protection.

Particle size analysis

Fines:	≥ 50%
Clay Content:	≥ 20%
Sand Content:	≤ 45%
Gravel Content:	≤ 50%

Atterberg Limits

Plasticity Index (PI):	11% ≤ PI ≤ 30%
Liquid Limit (LL):	30% ≤ LL ≤ 60%

A professional geoscientist may alternatively provide data or a design that will provide a level of protection that is an equivalent to the above alternatives.

An important part of a site characterization study is to determine the level of the water tables in the vicinity of the proposed liquid nutrient storage facility. There can be several water table levels on a building site. Some of these occur naturally, while others may have been caused by other construction projects. Constructing any part of a storage facility below a water table is not advised. In some cases, a water table can be artificially lowered by providing a drainage system surrounding the storage. This drainage system would require a monitoring catch basin to show that no direct contamination is occurring.

In some problem soils, the best alternative may be to make use of a synthetic, geosynthetic or engineered soil liner to provide secondary containment. With two levels of protection for the environment, the protection offered by the proposed building site becomes less critical.

- **Supervision** – the construction or expansion must take place under the supervision of a professional engineer.
- **Commitment certificate** – the engineer must sign the Engineer's Commitment Certificate (see *Appendix I*) prior to the construction. The farmer must submit this with the Nutrient Management Strategy.
- **Alternative design** – an engineer can produce a design that is equivalent to or makes use of materials that are equivalent to those referred to in the Act or Regulation.

APPENDIX B: ENGINEER COMMITMENT CERTIFICATE – FORM A

Project:
Name / Location

This is to Certify that I:

Owner

Signature

Date

understand that under the Nutrient Management Act, 2002, I am required to retain engineering services for specific projects and situations. Therefore I have retained the following Professional Engineer:

Engineer's name

Signature

Date

to undertake the overall coordination and completion of the engineering design and general review of construction; or

I have retained the following Professional Engineers to provide engineering services for the following components of the engineering design and review of construction:

Design Component	Engineer's Name	Engineer's Signature	Address	Phone
Site Characterization * - sub-surface information, soil properties, water table and bedrock location (if critical)				
Liquid Storage Facilities – drawings and design details for liquid storage construction				
Solid Storage Facilities – drawings and design details for solid storage construction if applicable				
Earthen Storage Facilities – drawings and design details for earthen storage construction				
Synthetic or Natural Liner – design details, including details of inspection and testing of seams.				
Transfer Systems – drawings and design details for connections, materials, etc.				

**Do you know about Ontario's new
Nutrient Management Act?**

The provincial Nutrient Management Act (NMA) and the Regulation 267/03 regulates the storage, handling and application of nutrients that could be applied to agricultural crop land. The objective is to protect Ontario's surface and groundwater resources.

Please consult the regulation and protocols for the specific legal details. This Factsheet is not meant to provide legal advice. Consult your lawyer if you have questions about your legal obligations.

For more information on the NMA, call the Nutrient Management Information Line at 1-866-242-4460, e-mail nman@omafra.gov.on.ca or visit www.omafra.gov.on.ca.

Factsheets are continually being updated so please ensure that you have the most recent version.

Agricultural Information Contact Centre
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